Strictly additive 2-designs

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This work draws inspiration from an interesting theory developed in [1]. A design $(V, \mathcal{B})$ is said to be *additive* if V is a subset of an abelian group G and the elements of any block $B \in \mathcal{B}$ sum up to zero. We propose to speak of a *strictly additive* design when V coincides with G.

Up to last year, apart from the obvious examples of the $2-(q^n, q, 1)$ designs associated with the affine geometry $\mathrm{AG}(n, q)$, all known strictly additive 2-designs had a quite "big" λ. Very recently, a strictly additive $2-(81, 6, 2)$ design has been found in [3]. This design, besides being *simple* (the only design with these parameters previously known [2] has sixteen pairs of repeated blocks), has the property that every block is union of two parallel lines of $\mathrm{AG}(4, 3)$.

In the attempt of getting other strictly additive designs with this property we found some infinite series of 2-designs whose parameter-sets are probably new.

In this talk, besides presenting the above series, I will try to outline a proof that for every odd k, there are infinitely many values of v for which a strictly additive $2-(v, k, 1)$ design exists.

[1] A. Caggegi, G. Falcone, M. Pavone, *On the additivity of block designs*, J. Algebr. Comb. 45, 271–294 (2017).
[2] H. Hanani, *Balanced incomplete block designs and related designs*, Discrete Math. 11 (1975), 255–369.
[3] A. Nakic, *The first example of a simple* $2-(81, 6, 2)$ *design*, Examples and Counterexamples 1 (2021).